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ABSTRACT

In 1989, a study was conducted at Riverside Community College (RCC) using regression analyses to predict grades as well as student success (C grade or better) in political science and history courses. Initial independent (predictor) variables included placement test scores on each of the three ASSET tests of baskc sills (reading, language usage, and numerical skills), as well as seven other variables: age, gender, ethnicity, whether the student had declared a major, whether the student had declared a definite educational goal, whether the student attended class at night, and an instructor variable. Subjects for the study were students, mostly freshmen, enrolled in the spring of 1989 in either Political Science I or one of four history classes and students who had also taken all three ASSET tests of basic skills the previous summer. The final number of subjects unique to each analysis was 105 for political science and 322 for history. After various statistical analyses were applied to the data, the major conclusions of the study were as follows: (1) ASSET scores were useful for predicting success or grades in history but not in political science at RCC; (2) mathematics test scores might be effective predictors of grades for certain nonmathematical courses such as history; (3) older students tended to have greater success and achieved higher grades in both political science and history; (4) evening students fared better gradewise in history than did their daytime counterparts, even after controlling for age and instructor effects; (5) the instructor variable generally had a profound effect on the success of students in certain courses and was found to operate as a suppressor of the fact that evening students outperformed day students in history; and (6) the utilization of both the inclusion and the exclusion of droppers in tandem in the study was conducive to the formulation of greater overall insights. An appendix containing the raw statistical data in eight tables is attached. (JMC)

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Prediction of Success and Grades in Political Science and History: A Matriculation Study

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ABSTRACT

A study of 105 and 322 students who took Political Science 1 and Introductory History courses at Riverside Community College a semester after their having taken the ASSET tests of basic skills--Reading, Language Usage, and Numerical Skills--was conducted using logistic regression, discriminant analysis, and stepwise linear multiple regression in order to examine the relationship between students' test scores on the ASSET and their performance in these courses as measured by 1) successful course completion and 2) course grade. In addition to test scores, seven other potential predictor variables were examined: age; gender; race; whether the student had enrolled in a day or evening section, had declared a major, or had declared a definite educational objective; and an instructor variable. For political science no significant correlation between any ASSET subtest and either performance criterion was found; only age was found to be a significant predictor of performance, accounting for 5% and 8% of the explained variance in success and grades, respectively. For history significant Pearson product-moment correlation coefficients were computed between each criterion and each subtest, grades yielding the higher values, i.e., .35, .29, and .30 with Reading, Language Usage, and Numerical Skills, respectively. Success in history is predicted by age, language scores, and instructor differences, with the instructor variable explaining the largest amount of variance. Student numerical skills scores and the fact that evening history students outperformed their daytime colleagues were included along with age, language scores, and instructor differences in the equation for predicting history grades--age being the major factor. The results are discussed in terms of their relationship to the assessment literature and with respect to the process of matriculation. The importance of the instructor variable, ISQ for Instructor Success Quotient, is emphasized.

BACKGROUND

On September 30, 1986 Governor George Deukmejian of California signed into law the Seymour-Campbell Matriculation Act (AB3, Chapter 1467, Statutes of 1986) which established state funding and guidelines for the implementation of matriculation in the California community colleges (Kasabian, 1989). Two years later the State Legislature passed AB 1725 which built on the 1960 California Master Plan for Higher Education by reaffirming and redefining the comprehensive mission of the community colleges (CCs) while offering a blueprint by which to guide the CCs into a more collegial mode of operation--e.g., by strengthening the role of the faculty senate, by increasing funding for staff development and instructional improvement, by adopting regulations for establishing the definitions and minimum qualifications for hiring faculty members and administrators (Board of Governors California Community Colleges, 1988). The 1980s have seen critics of CCs demand of them more quality and accountability (Hector, 1984), and clearly AB 3 and AB 1725 are offspring of such demands, with many of their tenets and concepts mutually reinforcing to each other.

The primary purpose of matriculation according to the document Matriculation: Preliminary Report on First-Year Implementation issuing from the Board of Governors of the California Community Colleges (Meznek & Murdoch, 1989) is to promote and sustain the effort of students to achieve their educational goals by providing within the framework of the college's mission a program of support services

designed to meet the needs of individual students. Moreover, the report continues (p. 1): "The responsibility of the college is to provide an admissions process, and orientation to college services and procedures, pre-enrollment assessment and counseling, advisement and counseling for course selection, a suitable curriculum or program of courses, follow-up on student progress with referral to support services when needed, and a program of institutional research and evaluation (emphasis mine)." Key here are the words assessment and institutional research and evaluation.

The idea of assessing students for placement at the time of enrollment certainly is not something new to community colleges. In the late 1960s and early 1970s placement testing of community college entrants did become slighted, however, in favor of allowing students to enroll in virtually any class they wished (Cohen & Brawer, 1987). Toward the end of the 1970s interest in placement testing was revitalized, primarily in order to retain students, as a decline in the number of eighteen-year-olds besieged the economies of many CCs. Cohen and Brawer (1984, p. 230) reveal that in 1970 only 28% of the CCs required testing. Yet, by 1983 according to a survey by Rounds (1984) nearly 7 out of 10 California community colleges either required or recommended testing for math, while nearly 9 out of 10 did so for English. Meanwhile in summarizing results obtained for thirty-eight colleges in six large urban districts in the United States, Cohen and Brawer (1987) point out the multitude of different placement tests being used--at least forty-four and many of these locally developed. Rounds and Anderson (1985) in a follow-up study

raised the additional flag that the wide range of registration and assessment practices prevalent in the California community colleges may not best serve the needs of students in a statewide system. Some commonly used standardized tests (discussed in the Related Research Section) are: The American College Test (ACT), the Nelson-Denny Reading Test (NDRT), the test of General Educational Development (GED), and the American College Testing Programs battery of tests known a ASSET--designed principally for use by the community colleges. Research is not lacking regarding in-house constructed tests for placement in English (Rasor & Powell, 1984) or mathematics (Kern Community College District, 1985); however, these will not be discussed here.

While assessment practices in the CCs have ridden a roller coaster in the past decade, planning and research have been, if not totally cast anew, then very much redefined, as sliding enrollments collided with the tax revolt, the "back-to-basics" movement, and more stringent competition among institutions for students. Strategic planning (Keller, 1983) was born! Many colleges began moving away from the mode of "muddling through" and began paying more attention to mission, mandates, situational assessment, and strategic issues, not as a reaction to budgetary pressures but rather as a precursor to the allocation of fiscal resources (Georgakakos, 1989a). Simultaneously program evaluation became more serious and frequent as the accountability movement strutted to center stage.

Thus, most logically and almost predictably, the Chancellor, in the spring of 1989, moved to support the institutional research and

evaluation component of AB 3 by spearheading the formation of the Matriculation Local Research Options Project. A Project Committee--affiliated with prominent organizations such as the California Association of Community Colleges (CACC), The Northern California Research Group (Norcal), Southern California Community College Institutional Research Association (SCCCIRA), and the California Community Colleges (CCC)--was called together and charged with developing a plan to 1) assist community colleges with local evaluation of matriculation, 2) publish possible research designs for use, and 3) compile the results from use of the research models in an aggregated report. In November of 1989 the Committee under the aegis of the Chancellor's Office published a document (Dunlap et. al., 1989) containing guidelines for various matriculation projects.

The present study was inspired by The Matriculation Local Research Options Project, Design #6 in Dunlap et. al. (1989). The research uses regression analyses to predict grades as well as student success (C grade or better) in Political Science I (American Government) and in History courses 4, 5, 6, and 7 (i.e., History of Western Civilization, 4 and 5; History of the United States, 6 and 7) for students enrolled at Riverside Community College. Ten initial independent (predictor) variables were employed: student test scores on the ASSET battery of basic skills--Reading, Language Usage, Numerical Skills; student gender, age, ethnicity; whether the student had declared a major; whether the student had declared a definite educational goal; whether the student attended the class at night; and an instructor variable.

The study answers a local and state research need. It also meshes well with the studies on assessment in higher education and with the growing body of important evaluative research on assessment beginning to emerge from the community college sector.

RELATED RESEARCH

Correlational Studies

Standardized tests used for selection/placement--such as those mentioned above--are usually validated via multiple regression analyses (Merante, 1983); nevertheless, most of the studies found in the literature which relate standardized test scores to outcome measures such as college GPA, course grades, or successful completion of a course are correlational in nature.

Decker (1974) in a study of Rhode Island Junior College students reported the following Pearson product-moment correlation coefficients (r) between ACT composite score and course average for students completing various courses: .47 for Accounting 1, .27 for Physical Science, and .24 for Quantitative Business Analysis 1.

Nolan (1977) correlated ACT subtest scores in English, math, natural science, and social science with course grades in corresponding subject courses at a West Virginia community college and concluded no significant relationship between ACT test scores and academic performance existed. On the other hand, Richards and Lutz (1967), in a comprehensive study involving 13 community colleges from

various parts of the country, reported r values averaging .39 for males and .47 for females for these same four subtests with college GPA.

Smith and Goetz (1988) from the results of their research at North Harris County (community) College suggest using GED scores when available for placement in lieu of ACT scores, since they found 1) a very high correlation of .80 between the GED and ACT composite scores and 2) the correlation of GED total test scores with GPA to be significantly higher than the correlation of total ACT scores with GPA, r=.30 vs .22, respectively.

In similar fashion Noble (1986) in research involving several midwestern universities determined that ACT subtests (English Usage and Social Studies Reading) could be used in place of the Nelson-Denny Reading Test (NDRT). At the CC level, Gudan (1983) has correlated NDRT total scores with various course grades for freshmen at Schoolcraft College in Michigan. Statistically significant relationships were not found in the two biology classes studied but were found in Business 101, r=.26; English 51 (remedial), r=.27; English 101, r=.26; and Political Science 105, r=.32. Sample sizes ranged from 40 in Biology 51 to 251 in Political Science. Emphasizing the small percentage of the variance in class grades explained by reading scores (i.e., r^2), the author was reluctant to extend too much educational significance to his results and advocated that NDRT total scores not be the sole criterion for prediction of student success in college.

Hector (1984) gave the NDRT to 211 students enrolled in first quarter psychology, sociology, and history courses at Walters State Community College in Tennessee. She computed significant r values of .34, .34, and .39 between total test score and class grades for the respective aforementioned courses. While recommending the use of the NDRT for placement purposes, this author is also cautious and makes a plea for the evaluation of alternative tests to see whether they might be as good or even better for assisting in the counseling of students.

One such candidate which is beginning to gain usage in the CCs is ASSET. ASSET is a battery of seven separate tests, three of which measure basic skills (Reading, Language Usage, and Numerical Skills), and four of which measure more advanced skills (Advanced Language Usage, Elementary Algebra, Intermediate Algebra, and College Algebra). Kochenderfer (1988) found at Riverside Community College in California r's ranging from .14 to .21 when ASSET subtests (Language Usage, Reading, Numerical Skills) were correlated with English grades. A study at Santa Rosa Junior College (1985) showed no correlation between any ASSET subtest of basic skills and English, history, or political science course grades. Moderate correlations were found for the Advanced Language Usage Test with grades in English 1A (composition) (.40) and with History 17A (.56).

Regression Studies

Regression analysis can often provide insights simple correlation cannot, since the effects of one independent variable on the dependent variable may be examined while controlling for the effect of other independent variables (Astin, 1970). While no regression study was found in the literature of which the present is a replica, several more or less related pieces have been gathered here to establish a mosaic of what is and to set a premise for what might be.

Balunas (1987) carried out a multivariate regression analysis to determine if number of hours worked per week was a significant predictor of GPA and persistence. The author concluded it was not; other variables--previous semester's GPA, number of children the student had, number of credits per semester--were.

Often in regression addition of more independent variables--be they academic, demographic, motivational, personality, college environment, or financial (see Lam, 1984; Merante, 1983)--will cause some erstwhile predictors to be abrogated from further consideration. For example, Astin (1977) has noted how standardized test scores add virtually nothing to the predictability of college grades once high school grades enter the regression; similar is the Balunas study above where GPA for the previous semester usurped over 96% of the explained variance in GPA for the current semester. On the other hand adding variables such as sex, age, level of parent education, and the like can and usually does meaningfully increase the overall correlation (multiple R) between predictors and the criterion (Astin, 1977, 1985).

Too frequently researchers at the community colleges do not have a raft of potential prognosticator variables available in their computer banks and must be content with what is at hand, which, particularly in the case of ex post facto research, is barely sufficient. Furthermore, upon reflection, it becomes fairly clear that the establishment of predictive equations in education is a dynamic enterprise. That is, one should not expect to come upon or for that matter set out to find a set of predictor variables immutably set in concrete and giving the one best regression equation for all time. Rather, one should seek out and try to define a set of critical variables representative and interpretive of a particular student population in a given educational environment at a given point in time so that any insights gained from a statistical analysis may be used to help each individual student (Merante, 1983).

A regression equation was developed by Mann (1976) to help identify students in a 2-year college in Mississippi who were enrolled in College General Chemistry. The major predictor, superseding both IQ and having taken a high school chemistry course, was ACT score. Noble (1986) reported a multiple R of.44 given by the American College Testing Program when ACT subtests are used to forecast freshman English grades.

In an effort to predict GPA of developmental studies students at a comprehensive community college, Hinkle and Polhamus (1983) found informal counselor prediction to be the largest contributor to the equation, about 60% more effective a predictor than placement reading or math scores.

A search for a set of variables to estimate the grades achieved by University of Portland (Oregon) students in five different majors (business, liberal arts, education, nursing, and engineering) led Corlett and Schendel (1987) to look at both traditional and nontraditional variables, where the traditional variables were English class writing grades, California Aptitude Test scores in reading and language skills, gender, race, and major; nontraditional variables were high school activities, high school attended, employment, preferred language, parent education, community and church activities. Results led these researchers to conclude traditional variables (especially the writing grades) are much better predictors of GPA than nontraditional variables.

Although the teacher variable is often discussed by various workers (Rhushan, 1985; Schurr, Houlette, & Ellen, 1986), rarely is the variable actually quantified and used as a predictor--nontraditional or otherwise--in community college research. When Cohen, Brawer, and Connor (1969) studied freshmen enrolled in introductory English in a California community college, they found a very high correlation of .71 between "hardness" in a teacher's grading and the number of students dropping the respective teacher's class. Spahr (1985) in a multiple regression study of the effect of several variables on student grades in Rhetoric I and College Algebra at an Illinois CC, found instructor differences accounted for 11% and 22% of the variance in the grades in these courses, respectively.

It was one of the major undertakings of the present research effort not only to investigate the role of traditional variables such

as placement test scores, age, ethnicity, gender, and the like but also to test for teacher effects. An instructor variable was constructed and is delineated in the section which follows.

METHODOLOGY

Subjects

Subjects for the study were students, mostly freshmen, enrolled as of 1st census in the Spring of 1989 in either Political Science I or one of the history classes described below and who had also taken all three ASSET tests of basic skills (Reading, Language Usage, Numerical Skills) the previous summer between June 6 and September 26, 1988, a testing period window of about 2 1/2 months selected so that the interval between assessment and actual classroom experience would be about the same for all participants. The site of the study was Riverside Community College (RCC), a large comprehensive two-year college of approximately 16,000 students, where about half enroll in day and half in evening classes--although two-thirds of the credit hours taken are in the day; 58% of the students are female, 66% white, 90% U.S. citizens, 87% reside within the district, and approximately 40% are less than 23 years of age (Office of Research and Planning, 1988, 1989). In order to avoid possible duplication of student input, 24 subjects were not included in the political science analysis because they were already in the history sample and another student who was taking two history classes was randomly assigned to the history group on the basis of participation in only one of the

courses. Thus the final N, with subjects unique to each analysis, was 105 for political science and 322 for history: these may be considered samples from a population of RCC students of comparable backgrounds who would take ASSET and enroll in one of the aforesaid courses of interest within, say, one-half year. This is of course a non-proven, tacit assumption of the study and, as such, is one of its limitations.

Materials

The American College Testing Program (1983) ASSET battery of basic skills--Reading, Language Usage, Numerical Skills (mathematics) which are used by the college for advisement and placement--were the three test instruments used: these have, according to ACT, test-retest reliabilities of .90, .88, and .89, respectively. Information about the validity of ASSET, largely presented in terms of predicting performance in various transfer and remedial courses may be found elsewhere (ACT, 1989: Kochenderfer, 1988). Approximately 67% of RCC's students take the ASSET (Vail, 1990).

Procedure and Definition of Variables

Background information about the courses, some of which is listed on the next page, was obtained from the college catalog (Board of Trustees, 1989):

Political Science I -- American Government

History 4 and History 5 -- History of Western Civilization, the former course covering from the Ancient Middle East through the Middle Ages; the latter, from the Scientific Revolution to modern times.

History 6 and History 7 -- Political and Social History of the United States. The former course covering from the Colonial Period through the Civil War; the latter, from Post-Civil War to the present time.

Each history course is a complete class and requires no prerequisite history course; hence all history classes were combined in the history analysis. A separate analysis was performed for political science, though it was suspected that the findings would mirror those for history. All courses met 3 semester hours per week and required qualifying ASSET Reading scores (many in the study did not meet this last criterion).

Data to be used in the statistical analyses were extracted from the RCC mainframe computer with assistance from the Office of Admissions and Computer Services under the auspices of the District's Office of Research and Planning. In addition to ASSET scores and course grades (A, B, C, D, F, W for withdrawal, or I for incomplete), pertinent available data included information about student age, gender, ethnicity, declared major and educational goal; and about course section, day or evening class, as well as, instructor. There were 30 and 12 sections of history and political science respectively taught by 14 and 5 different instructors, without duplication of instructors between disciplines. To protect anonymity all student and instructor names were translated into numerical code.

Definition of Variables

Variable Names	Description and Comments
dependent variables	
SUCC	A dichotomous variable. 0 = unsuccessfully completed course (grade of W, I, D, or F); 1 = successfully completed course (A, B, or C).
GRADE	Student grade A, B, C, D, or F, where F = 0 and A = 4. Treated as continuous.
independent variables	
NIGHT	Dichotomous. 1 = student enrolled in a day class; 2 = evening class.
RDG	ASSET Reading score, range 24-53, continuous.
LANG	ASSET Language Usage score, range 24-54, continuous.
MATH	ASSET Numerical Skills score, range 26-55, continuous.
AGE	Student Age. Continuous.
DECMAJ	0 = no declared major; 1 = declared a major (see below).
DEFGOAL	0 = no declared educational goal; 1 = declared some definite educational goal (see below).
WHITE	A dichotomous variable where 0 = minority (i.e., non-white); 1 = Caucasian-White (see below).
ISQ	Instructor Success Quotient. Assigned to each instructor as discussed below. Treated as continuous.

The last four listed independent variables--DECMAJ, DEFGOAL, WHITE, and ISQ--require further comment. Since 427 subjects declared 55 different majors, with 45% declaring "undecided" (leaving an average of 4 students per major), the majors variable was simply dichotomized as above on the premise that students who declared a

major would be more successful and obtain higher grades than those who did not.

Regarding ethnicity, preliminary crosstabulations revealed no significant differences between minority groups--Asian, Black, Hispanic.[1] In addition the numbers of students in the remaining minority categories--American Indian, Filipino, and Other Non-white--were small. Thus the variable WHITE was constructed by placing all minorities in one group and Caucasians in the other, to see if any advantage in grades accrued to being Caucasian.

The rationale behind the formation of collapsed variable DEFGOAL is similar to that for WHITE.

Finally, to compute ISQ's for each instructor, data for students who were not subjects, yet who were classmates of the subjects in political science or history were invoked as follows: division of the number of non-subject students who received a C grade of better by the total number of non-subject students enrolled as of first census allowed for the determination of an ISQ for each section. Thus if 20 out of 30 students successfully completed the class, an ISQ of .67 would be obtained for that section. It was noted that regardless of the number of sections taught, the ISQ for a given instructor was

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1. It should be noted that Astin (1985) has cautioned against lumping Asians together with other minorities, since Asians residing in the U. S., especially the Chinese and Japanese, may achieve educationally even at a higher level than whites; therefore, placement of Asians with other minorities could mask certain white/minority effects.

fairly constant from one section to the next. Average ISQ's for each instructor were therefore computed; the minimum number of "non-subject" students used to obtain any average instructor ISQ was 17, the maximum 181, and the mean was 67. All told data from 448 "additional" political science and 831 more history students were utilized. The computed ISQ's, as far as their predictive effect on the subject students, tend to be a composite of both instructor and peer effects. Still, by using students who did not qualify for the study, in terms of when ASSET was taken, for the determination of this independent variable, a much-less biased measure of how students fare under different instructors results than if the study's subjects had been used. Finally, while as ISQ of .30 for one instructor vs. .90 for another tends to conjure up a variety of diametric scenarios or comparisons--hard vs. easy grader (Cohen, Brawer, & Connor, 1969), incompatibility vs. compatibility between the personalities of the teacher and the students (Schurr, Houlette, & Ellen, 1986), creation of a negative vs. positive working atmosphere by the teacher (Rhushan, 1985)--it must be emphasized that it was not the intent of this research to prove or embrace any of these, only to see whether ISQ would be an effective independent variable in multiple regression.

Statistical Considerations

Statistical analyses were performed separately for political science and history in an effort to answer the following questions.

I. Which, if any, of the 10 independent variables affect or contribute significantly to the prediction of

   A. success in
      1. political science?
      2. history?

   B. grades in
      1. political science?
      2. history?

II. If the results obtained in I. are different for political science and history, how are they different?

The procedure of choice for part A, where the dependent variable is dichotomous, was logistic regression coupled with discriminant analysis procedures for adducing a most appropriate model. For part B, where the dependent variable is treated as continuous, the method of choice was stepwise multiple regression. Details about these procedures may be found in the following sources (Afifi & Clark, 1984; Kleinbaum, Kupper & Muller, 1988; SAS Institute, Inc., 1985; Georgakakos, 1989b).

RESULTS AND DISCUSSION

Correlation

Table 1 summarizes correlation results for the possible predictor variables with each of the dependent variables used for both the political science and history groups. Values which had a p value less than the $\alpha = .05$ level of significance are marked with an asterisk. As can be seen, only age appears to give any significant correlation

with political science, whether success or grades is the criterion. The correlation of .37 between ISQ and success in history drops to .20 when grades becomes the dependent variable: this should be expected since removal of subjects who either drop or receive an incomplete reduces variance in the instructor variable. The counter argument is used of course to explain the growth in correlations of LANG, RDG, MATH, and AGE when the continuous variable grades is used instead of the dichotomous variable success; and regardless of the dependent variable, these correlations are as one would expect--positive--that is those students who score higher on the ASSET tests of basic skills as well as older students tend to be more successful and get better grades in history. Notice also how the correlation between attending class in the evening becomes significant (.27) when grades are used in lieu of success. Not only is part of this growth explicable because of the larger amount of information contained in the grades variable but also because exclusion of W's and I's--a larger proportion of whom were from the night group--tends to inflate the fact that night students earn higher grades than daytime students. This finding may be verified by looking at the means of the NIGHT variable (see Tables A1 and A2 in the Appendix where basic statistics--means and standard deviations--for all variables are summarized). In addition, the increase in the means for AGE from 20.96 to 21.17 for history speaks for the persistence of the older students.

Some direct comparisons of the present correlation coefficients with previous research are possible. The lack of correlation of any ASSET test with course grades in political science parallels that

found at Santa Rosa Junior College (1985) for political science; however, Santa Rosa also found no correlation of ASSET with history grades, counter to the findings here where the size of r approximates the order of magnitude for most of the r values quoted earlier in the Related Research section. ACT (1989), on the other hand, very recently from data obtained on 412 students in six community colleges published a value of .34 for the correlation, between history grades and ASSET reading scores; the value in Table 1 is .35.

Table 1 Correlations of Independent with Dependent Variables for Political Science and History Courses.

	Success		Grades	
Independent Variable	Politic Sci (N = 105)	History (N = 322)	Politic Sci (N = 85)	History (N = 224)
NIGHT	.02	.02	.13	.27*
LANG	-.14	.21*	-.05	.29*
RDG	.01	.20*	.07	.35*
MATH	-.07	.15*	-.02	.30*
AGE	.22*	.20*	.29*	.40*
SEX	.03	.04	.17	.09
WHITE	0.00	.09	-.06	.11
ISQ	.10	.37*	-.10	.20*
DECMAJ	.12	.07	.11	.13
DEFGOAL	-.01	.05	.07	.10

* Statistically significant $p < .05$.

Prediction of Success: Discriminant Analysis and Logistic Regression

When prior probabilities of belonging to two groups are not lopsidedly unequal, when assumptions about normality of variables are met, and when samples are of sufficiently large size, the methods of logistic regression and two group discriminant analysis should yield comparable results and may be used to complement one another

(Georgakakos, 1989b). Logistic regression, however, being a maximum likelihood method, does not require any assumptions about normal distributions, and is applicable for any combination of discrete and continuous variables. Furthermore, when the dependent variable (such as SUCC) is dichotomous, logistic regression should take precedence over conventional least squares multiple regression (Afifi & Clark, 1984). From Table A1 in the Appendix it may be noted the (prior) probabilities for success are .60 and .48 for political science and history. In addition normality and sample size conditions were fairly well met, so that logistic regression and discriminant analytic procedures could be applied in complement.

This approach notwithstanding, the results for political science were uninspiring in terms of the number of predictors and total amount of explained variance in the criterion success. Both stepwise discriminant analysis and logistic regression pointed to a one variable model involving AGE (not unexpected as perusal of Table 1 will affirm). The logit equation is:

$$\ln\left(\frac{P_S}{1 - P_S}\right) = -1.694 + 1.004\ AGE \qquad \text{Equ (1)},$$

where P_S is the probability of being successful in political science class and $1-P_S$ the probability of being unsuccessful; the ratio $P_S/(1-P_S)$ is referred to as the "odds" of being successful--it is the natural logarithm of the odds that forms the linear relationship with predictors. Multiple R^2 for the model is .0496, i.e., about 5% of the

variance in students success in Political Science 1 can be attributed to age.

Calibration and test groups were established by randomly assigning half the political science subjects to one group and half to the other; the ensuing discriminant analysis revealed rates of correct classification could not be increased beyond the laws of chance: All successful students were correctly classified, all unsuccessful ones misclassified--the computer, lacking sufficient predictive power from a discriminating variable, simply used priors .6 and .4 for the successful and unsuccessful probabilities and, in trying to minimize error, lumped all students into the former category.

For forecasting success in history courses, both discriminate analysis and logistic regression procedures yielded a three variable model. The logit equation here is:

$$\ln\left(\frac{P_s}{1 - P_s}\right) = -8.896 + 6.534\ ISQ + .0982\ AGE + .0728\ LANG \qquad \text{Equ (2)},$$

where P_s now is the probability of success in history. Reading scores (which correlate somewhat with age--Table A3) was not selected. Multiplying the unstandardized coefficients of Equation 2 by the standard deviations of the respective variables in Table A1 produces a set of standard coefficients: .993 for ISQ, .577 for AGE, and .416 for LANG; these give a more succinct measure of the relative contribution of each variable. On this basis one can see ISQ, the instructor variable, is about two and a half times more potent a predictor of whether a student will pass history than is the student's

score on the ASSET Language Usage exam. All told, the model accounts for about 22% of the variance (multiple R = .464) in the success variable, and using the standard coefficients, instructor differences can be seen to account for about half of the explained variance.

Looking at the prior probabilities for successful or unsuccessful completion of history--.48 and.52, respectively--one can see that without use of abetting knowledge the odds of correctly classifying a student are about even. Discriminant analysis using the three predictor model, however, revealed a different scenario which is summarized in Table 2. Here, unlike the situation for political science, the chances for correct classification are substantially improved: 111 unsuccessful and 114 successful students are correctly classified producing hit rates of 65.7% and 74.5%--about 16 and 25 percentage points higher than if simple hit rates of 50% are used. While prediction is not scintillatingly perfect and 3 out of 10 students are in fact misclassified, the potential of the model is in evidence.

ASSET scores per se, while not being effective predictors of course grades, may indeed predict well for students whose scores are either very high or very low: concludes Professor Johnson (1987, 1990) from his study of ASSET scores and grade distributions in various courses at Riverside Community College. For example, if one uses Equation 2 to compute the odds of success for a 20-year-old

Table 2 Classification of History Students into Unsuccessful (0) or Successful (1) Categories of Course Completion with Age, Language Score, and the Instructor Variable as Discriminators.

From SUCC	0	1	Total
0	111 (65.7)	58 (34.3)	169 (100)
1	39 (25.5)	114 (74.5)	153 (100)

Note Percentages for each category are in parenthesis under the actual numbers. These percentages are about the same as those obtained on a test group on half the history students, using the other half for calibration.

who received a low score of 35 on the Language Usage examination and whose instructor's ISQ was .552 (the mean from Table A1), one gets .459. Computing the odds for another student, same age and instructor, only for a language score of 50 yields a value of 1.369. In other words the odds of successfully completing history is three times greater for the student who scores high on the ASSET exam than for the one who scores low; this fact obtains when all other variables are held constant despite what some might consider only a moderate multiple R^2; i.e., models such as Equation 2, when used conscientiously, can have great predictive value and should therefore not be lightly dismissed.

Prediction of Grades: Least Squares Multiple Linear Regression

Table 3 gives the slopes, intercepts and R^2 for the regression of grades on possible predictors. Again, for political science the only

predictor was found to be age. However for history, removal from consideration of nearly one hundred students who dropped changed relationships enough so that--in addition to age, ISQ, and language scores--new predictors, math score and whether the class was taken during the day or at night, entered the regression. The fact that math rather than reading scores entered the equation can at least be partially understood from the intercorrelations between math, reading, and language in Table A4 of the Appendix, where math scores correlate more highly with reading than with language scores; and language scores correlate more highly with reading than with math scores--viz., more of the total explained variance in grades can be accounted for by the variables LANG and MATH. That NIGHT is a predictor may be seen in light of the fact that removing droppers from the study proportionately has greater impact on the evening group which dropped at a higher rate--39% compared to 29% for day classes. In effect the presence of the proportionately larger number of droppers in the night sample when SUCC was the dependent variable suppressed the significance of NIGHT as a predictor in logistic regression. Removal of the droppers likewise removes this supressor effect.

A second supressor effect should also be noted. Average ISQ's for day instructors were about .1 points higher than for evening instructors (irregardless of the dependent variable); this happenstance became obvious when ISQ entered the regression revealing a 50% growth in the partial correlation between GRADE and NIGHT--the next variable to enter. In short, when one controls for the fact that day instructors apparently graded more easily than their evening

counterparts, one finds the evening students do even better than one would expect from a first hand reading of the simple correlations given earlier in Table 1.

Returning to Table 3, notice the standardized beta coefficients in the last column: no longer is ISQ the primary predictor as it was in Equation 2. Now it is AGE, about 1.26 times as influential as ISQ and approximately equivalent to the combined effect of the ASSET Language Usage and Numerical Skills scores. Nonetheless, ASSET's predictive capabilities here should not be underestimated. If one

Table 3 Regression Equation Coefficients

	Political Science (N = 85)		History (N = 224)	
Variable	b	β	b	β
AGE	0.0578	0.288	0.0683	0.3426
MATH			0.0416	0.1839
ISQ			2.6944	0.2714
NIGHT			0.7200	0.1832
LANG			0.0391	0.1752
Constant	0.9393	0	-5.1859	0
R^2	0.083		0.343	

uses the b values given for history in the table to compute grades for two 20-year-old day students in the same class (ISQ = .6), only that one student scores 40 in both Language Usage and Numerical Skills while the other scores 50 on both, the result is a difference of about 1 GPA unit--the difference between a D and a C.

Additional differences between students with high and low ASSET scores are highlighted in the Appendix in Tables A5 through A8 which contain basic statistics for extreme groups selected as follows:

Students were considered part of the low group if their reading scores were below 38, the RCC cut off for taking English 1A and other courses. Those whose reading scores exceeded 48, that is in the top 10% locally as well as nationally, were culled into the high group.

Finally, as would be hoped, no correlation of any kind between grades and the residuals of observed and predicted grades was found--further supporting a linear regression model.

CONCLUSIONS

Methodologically the statistical soundness of the models developed herein has been tested and upheld: nevertheless, from a practical standpoint no elixir for prediction of success or grades in political science or history has emerged. For political science, age is certainly a predictor, though a lonesome and essentially ineffective one. For history, a prognosis for success may be made with substantial improvement over chance because of the combined effects of variables age, ASSET Language Usage score, and instructor differences (i.e., ISQ), with the last variable figuring most prominently. Prediction of history grades thrusts age to the forefront of forecasting ability, adds math scores and day or night class status to age, language scores and ISQ, while increasing the amount of explained variance in the dependent variable from 22 to 34 percent. Trenchantly different outcomes are specified by the history models for students who score either very high or very low on

ASSET--from a whole letter grade difference to a tripling of the odds of passing or not.

The instructor variable is important in both history models: it accounts for 11% and 8% of explained variance in successful course completion and course grades, respectively--reminiscent of the finding by Spahr (1985) that instructor differences explained 11% of the variance in Rhetoric I grades.

In sum the following conclusions are warranted:

1. ASSET scores are useful for predicting success or grades in history but not political science at RCC.

2. ASSET scores, while helpful for counseling students for some courses, may be of little or no value for such purposes in other courses.

3. Mathematics test scores might be effective predictors of grades for certain nonmathematics courses such as history (see Culyer, 1988).

4. Older students tend to have greater success and achieve higher grades in both political science and history.

5. Evening students fare better gradewise in history than do their daytime counterparts, even after controlling for age, and instructor effects. (Perhaps motivational factors come into play).

6. The instructor variable can have profound effect on the success of students in certain courses. It should not be overlooked, lest an unclear picture of the data emerge. In this study this variable has been found to operate as a supressor of the fact that evening students outperform day students in history.

7. Inclusion of droppers (and incompletes) in the study is to lose some of the information furnished by grades and lowers the overall multiple R^2. To exclude them, while increasing R^2, is to run the risk of creating a distorted half picture of the student population. Each approach has its merits: to utilize them in tandem is conducive to the formulation of greater insights.

Suggestions for Further Research

A revelation of Table A1 is that there is not a significant difference between the political science and history student with respect to mean scores on the ASSET Reading or Language Usage exams. yet the latter factors quite conspicuously into the equation for success in history while appearing not to do so for political science. A study should be undertaken to investigate the language usage and readability requirements in the two courses as a means of substantiating or calling into question the results obtained here.

Second. especially in view of the political science results. it becomes imperative to seek to establish adequate. informative. cogent predictors for those courses where forecasts of student success or achievement are desired. Kochenderfer (1988) found. when LASSI variables--which measure students' learning and study strategies--were used as predictors additional to student ASSET scores. that the amount of explained variance in grade point average rose from 8 to 24 percent. A concerted effort must be made to accumulate as much information about community college entrants as is humanly possible within the constraints imposed by time. Instruments to supplement ASSET such as the LASSI or those used by Astin and others (1988) are strongly suggested.

Third. a detailed study whose purpose it is to establish ISQ's and other variables related to teacher differences ought to be initiated: these must be refined and made available for use in statistical treatments. As a corollary here is the suggestion of

Hinkle and Polhamus (1983) to incorporate informal counselor predictions into quantifiable models. It is intriguing to ponder about a CSQ--Counselor Success Quotient--a variable related to a counselor's overall effectiveness in assimilating input data on a student and translating it into a prediction about the student's chances in a given course. Yet it is more than a prediction: it becomes for many students the stop or go to a perceived future. Counselors constantly use assessment and other data in their deliberations before advising students. To ignore the counselor variable will more than likely serve to suppress knowledge of the true impact of assessment on a number of student outcome measures. Testimony here comes from Santa Rosa Junior College (1985) where it was found that students taking courses recommended by counselors were more successful overall than the students taking non-recommended classes.

Finally, the development of better statistical models for predicting student success should be a college-wide goal. This makes good sense from a research and planning. assessment. evaluation perspective. It also makes good sense from the perspective of the mission statements of most colleges and that elucidated earlier as the purpose of matriculation.

APPENDIX

Tables A1 and A2 give the basic statistics for both courses with and without inclusion of W's and I's. In addition to the numbers provided in the tables, preliminary analyses of the histograms of all

variables disclosed that only one variable AGE displayed any marked skewness away from normality, being highly positively skewed since several students were in fact more than 25 years older than the mean ages shown. Even this departure, however, was not considered debilitating to the analysis.

Tables A3 and A4 display the correlation matrices among independent variables for each group for each dependent variable. To avoid clutter, only those values found to be statistically significant at the α=.05 level are given, with political science and history numbers reported above and below the diagonals, respectively. As can be seen changing the criterion from successful completion of a course to course grades in going from Table A3 to A4 causes but slight alteration in the values, two marginally significant numbers in Table A3 disappearing in Table A4, while a new r=.22 between language scores and WHITE surfaces. While lending completeness to the study by making certain intercorrelational values immediately accessible to readers, especially those who might wish to know how ASSET sub test scores correlated with each other, the tables also signal that multicollinearity should not be a problem among these variables in regression. This anticipation was indeed borne out in the regression analyses since no minimum tolerance of any predictor ever became less than .7, meaning no more than 30% of the variance of any independent variable could be accounted for by other independent variables in the equation (SPSS Inc., 1988).

Summarized in Tables A5, A6, A7, and A8 are means and standard deviations for groups of students for each course with extreme reading

scores--low group, RDG<38: high group, RDG>48--with and without droppers included. Political science numbers reveal significant mean differences only on the test variables--LANG, RDG, MATH. The picture for history is more varied when the question about differences in high and low group means for specified variables is raised. Of course having a larger N per group allows for greater statistical power upon which to declare significant differences. This notwithstanding it is clear from reviewing the tables, especially A6 and A8 that students who score high in reading tend to score high in language usage as well as in numerical skills, they get significantly better grades in history, tend also to do better in political science, are older, more likely to be white, and more apt to have declared a major rather than be undecided.

Table A1 Basic Statistics for Political Science and History: W's and I's Included

	Political Science (N=105)		History (N=322)	
Variable	Mean	Std Dev	Mean	Std Dev
SUCC*	.600	.492	.475	.500
NIGHT	1.152	.361	1.127	.334
LANG	42.610	5.350	42.335	5.710
RDG	42.524	4.952	41.969	5.393
MATH*	43.752	4.655	42.311	5.294
AGE	21.438	5.909	20.960	5.874
SEX	1.590	.494	1.528	.500
WHITE	.667	.474	.674	.470
ISQ*	.676	.104	.552	.152
DECMAJ	.524	.502	.553	.498
DEFGOAL	.829	.379	.764	.425

* Variable on which means of the two groups differ significantly $p < .05$.

Table A2 Basic Statistics for Political Science and History: W's and I's Not Included

Variable	Political Science (N=85) Mean	Std Dev	History (N=224) Mean	Std Dev
GRADE	2.200	1.261	2.071	1.240
NIGHT	1.129	.338	1.112	.316
LANG	42.341	5.213	42.804	5.559
RDG	42.694	5.085	42.210	5.467
MATH*	43.776	4.607	42.272	5.477
AGE	21.800	6.277	21.170	6.219
SEX	1.553	.500	1.518	.501
WHITE	.682	.468	.723	.448
ISQ*	.688	.095	.586	.125
DECMAJ	.529	.502	.536	.500
DEFGOAL	.835	.373	.781	.414

* Variable on which means of the two groups differ significantly $p < .05$.

Table A3 Significant Intercorrelations among Independent Variables when Success is the Criterion

	NIGHT	LANG	RDG	MATH	AGE	SEX	WHITE	ISQ	DECMAJ	DEFGOAL
NIGHT	---				.40			-.43	.30	
LANG		---	.46	.27						
RDG	.16	.50	---	.52			.24			
MATH		.46	.46	---		-.42				
AGE	.30		.21		---			-.26	.25	
SEX		.22				---				
WHITE		.28	.29	.18			---			
ISQ	-.18							---		
DECMAJ					.16				---	.22
DEFGOAL			.12						.13	---

NOTE: Correlations for political science (N=105) are shown above the diagonal and for history (N=322) below the diagonal

Table A4 Significant Intercorrelations among Independent Variables when Grades is the Criterion

	NIGHT	LANG	RDG	MATH	AGE	SEX	WHITE	ISQ	DECMAJ	DEFGOAL
NIGHT	---				.44			-.37	.29	
LANG		---	.44				.22			
RDG	.14	.49	---	.50			.29			
MATH		.43	.49	---		-.41				
AGE	.34		.24		---			-.28	.23	
SEX		.23				---				
WHITE		.26	.26				---			
ISQ	-.24							---		
DECMAJ					.16				---	.21
DEFGOAL			.18						.14	---

NOTE: Correlations for political science (N=85) are shown above the diagonal and for history (N=224) below the diagonal

Table A5 Basic Statistics for Political Science for Low (RDG<38) and High (RDG>48) Reading Groups: W's and I's Included

	Low Group (N=17)		High Group (N=9)	
Variable	Mean	Std Dev	Mean	Std Dev
SUCC	.647	.493	.778	.441
NIGHT	1.133	.341	1.122	.441
LANG**	36.824	4.066	44.444	4.720
RDG**	34.765	2.386	50.222	1.202
MATH**	40.706	4.441	49.556	3.941
AGE	22.118	6.489	23.778	6.815
SEX	1.706	.470	1.333	.500
WHITE	.412	.507	.667	.500
ISQ	.642	.137	.649	.140
DECMAJ	.412	.507	.556	.527
DEFGOAL	.765	.437	.667	.441

** Variable on which means of the two groups differ significantly $p < .001$.

Table A6 Basic Statistics for History for Low (RDG<38) and High (RDG>48) Reading Groups: W's and I's Included

Variable	Low Group (N=69) Mean	Low Group (N=69) Std Dev	High Group (N=40) Mean	High Group (N=40) Std Dev
SUCC**	.391	.492	.775	.423
NIGHT*	1.058	.235	1.250	.439
LANG**	38.406	5.051	47.275	4.523
RDG**	34.710	2.230	50.600	1.277
MATH**	39.087	5.365	46.550	4.107
AGE*	20.449	6.053	24.450	7.612
SEX	1.449	.501	1.600	.496
WHITE**	.464	.502	.875	.335
ISQ	.554	.162	.567	.127
DECMAJ	.597	.495	.650	.483
DEFGOAL*	.696	.464	.900	.304

NOTE: Variables on which means of two groups differ significantly are marked with an asterisk. * p <.05; ** p <.001.

Table A7 Basic Statistics for Political Science for Low (RDG<38) and High (RDG>48) Reading Groups: W's and I's Excluded

Variable	Low Group (N=14) Mean	Low Group (N=14) Std Dev	High Group (N=8) Mean	High Group (N=8) Std Dev
GRADE	2.071	1.072	2.750	1.035
NIGHT	1.143	.363	1.125	.354
LANG**	36.714	4.286	44.250	5.007
RDG**	34.571	2.441	50.125	1.246
MATH**	40.429	4.767	49.125	3.980
AGE	22.357	6.968	23.000	6.845
SEX	1.643	.497	1.375	.518
WHITE	.357	.497	.625	.518
ISQ	.694	.080	.683	.103
DECMAJ	.429	.514	.500	.535
DEFGOAL	.786	.426	.625	.518

** Variable on which means of the two groups differ significantly, p <.001.

Table A8 Basic Statistics for History for Low (RDG<38) and High (RDG>48) Reading Groups: W's and I's Excluded

Variable	Low Group (N=45) Mean	Low Group (N=45) Std Dev	High Group (N=32) Mean	High Group (N=32) Std Dev
GRADE**	1.800	1.120	3.250	.880
NIGHT	1.089	.288	1.250	.440
LANG**	39.600	4.755	48.031	3.980
RDG**	34.756	2.197	50.688	1.256
MATH**	38.667	5.604	46.938	4.158
AGE*	20.600	6.699	25.063	8.191
SEX	1.467	.505	1.688	.471
WHITE**	.511	.506	.906	.296
ISQ	.598	.130	.594	.077
DECMAJ*	.533	.505	.594	.499
DEFGOAL	.733	.447	.969	.177

NOTE: Significant differences between group means * p <.05: ** p <.001.

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